Game Physics – Programming Exercise

Exercise 4 – *Open Project*

Task Overview

The goal of the open project is to extend your previous simulation code and generate some interactive and interesting physical demos. For this, create **a coupled simulator** that combines at least two of the previous exercises, which two is up to you. (If you plan to include Exercise 3, we recommend that you turn it into an **SPH simulator** first, as outlined below.)

Some ideas:

- Couple rigid bodies with your mass spring system.
- Or exchange forces between rigid bodies and particles in SPH.
- Alternatively, you can be creative – but also be realistic (don't try to do too much), and always start with tests that are as simple as possible.

Recommendations & Tips:

1. **SPH simulator:** The sphere collision simulator in the third exercise is very close to a SPH simulator. When implementing exercise 3, for a given sphere, you calculate the collision force from its neighbor spheres. In SPH simulator, for a given particle, we find its neighborhood, and calculate the particle densities, then evaluate pressure and gravity forces, and integrate positions and velocities in time with an Euler step. The following thesis contains useful tips for implementing SPH: http://image.diku.dk/projects/media/kelager.06.pdf
2. **Force based coupling:** You could implement a force based coupling between two of your previous simulations. E.g., add forces from a mass-spring system to your rigid body simulation, and implement a collision-detection between its mass points and the boxes (either as force or position constraint). Or exchange forces between rigid bodies and particles in SPH. With this coupling, you can have interactions between rigid bodies and elastic bodies (mass spring system), and even fluids.

Demo requirements:

- **Coupled simulation:** Implement and test your coupled simulator.
- **Demo Scene:** Once your simulator works, create a complex scene with it that is as large scale as possible (i.e. involves as many points/particles/objects as your simulator can handle).
- **Optional - Game Logic:** as an optional task you can implement a simple game logic in your simulation. Think of a play target and scoring mechanism for your simulation. However, this is not mandatory.

Submission

In contrast to previous exercises, you don't need to submit exercise 4 to your tutor. Instead, you should do a in-class Demo and a Group Presentation.

- **In-class Demo:**
  present your **open project** on **the lecture,** on **Mon. Jan 29th.** Briefly explain how you coupled different simulators to the class, and then demonstrate it to show interactions between different objects. In total, use less than **5 minutes**. Test your notebook in combination with the projector in *HS2-Hochbrueck* before Jan 29th.
- **Group Presentation**:
  present your **open project as well as the first three exercises** on Feb. 1st (Thu.), or Feb. 2nd (Fri.). Details about what to present, and how to sign up will follow in 2018.